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DEPARTMENT OF OCEAN DEVELOPMENT
GOVERNMENT OF INDIA
NEW DELHI

Postal Address :

Department of Ocean Development
Government of India
South Block
New Delhi-110011.

ted at Pooja Press & Prakashan Pvt. Ltd., B-167, 168, 169 D.D.A. Sheds, Okhla Industrial Area, Phase-I
v Delhi-110020 Phone : 632314

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1. INTRODUCTION

Oceans are known to be our last frontiers. The oceans cover about two-thirds of the planet earth and are the storehouse of food, minerals including oil and gas, energy, etc. For India, oceanography is relatively a young science. A systematic study of the Indian Ocean started with India's participation in the International Indian Ocean Expedition (1960-65). Earlier to this, interest was shown only on a few aspects of the ocean science by some institutions and universities. In 1966, the National Institute of Oceanography came into existence and began to pursue, with limited resources, multidisciplinary studies of the ocean. These were not commensurate with India's vast coastline of more than 7000 km.

As our technology advanced in complexity, the relentless quest towards resources of the ocean assumed greater importance.

As time passed, several agencies and institutions began to work in the ocean sector. The Ministry of Agriculture and the Indian Council of Agricultural Research became directly concerned with the survey and assessment of living resources, the Oil and Natural Gas Commission with the exploration and exploitation of hydrocarbons, the Central Salt and Marine Chemicals Research Institute with the chemicals found in the sea water and the Department of Space and the National Remote Sensing Agency with the satellite imagery and photointerpretation techniques related to oceans. Other institutions like the Engineers India Ltd., the Indian Institutes of Technology, the Bhabha Atomic Research Centre, several Universities, the Central Water and Power Research Station, Ministry of Shipping, Naval Hydrographic Office, India Meteorological Department, and Geological Survey of India and the Ministry of External Affairs began contributing in specific areas of their interest.

The declaration of 200 mile Exclusive Economic Zone added new dimensions to the developmental programme of the oceans. Since the sea contains practically everything what is found on land, the development and utilization of these resources can make a considerable impact in improving the living standard of our people and the growth of economy of our country.

2. CREATION OF A NEW DEPARTMENT

The Government of India, with above aspects in view, created a new Department of Ocean Development (DOD) through President's Notification No.CD 800/81 dated 24th July 1981 directly under the Prime Minister. The various activities to be dealt by DOD as notified are :

1. Matters relating to the ocean and not specifically allocated to any Department/ Ministry

2. Policies including coordinations, security, regulatory measures and development relating to the ocean and covering

   (i) research (including fundamental research) and the development of uses relatable thereto;
   (ii) technology development;
   (iii) surveys to map and locate the availability of non-living and living resources;
   (iv) preservation, conservation and protection;
   (v) development of appropriate skills and manpower;
   (vi) collaboration, including technical collaboration; and
   (vii) laws relatable to the above

3. Ocean Commission

4. The Pan-Indian Ocean Science Association

5. Ocean Science and Technology Agency or Board

The Department of Ocean Development (DOD) is expected to deal with the new and emerging programmes of ocean development both at the national and international levels.

The Department started functioning in July 1981 under the Cabinet Secretariat, and from March 1982 as a separate Department under the Minister of State with a Secretary and other technical and administrative staff.

The Indian Institute of Management (IIM) was requested to prepare a plan for the management and administrative functioning of the Department. The first report of IIM is available as a guideline for the structure and functions of the new Department. A second and more detailed report is expected to be received soon.

(A) Role and Activity

The Department intends to focus its attention on the following seven areas of activity under different groups:

(i) Living resources
(ii) Non-living resources
(iii) Ship management
(iv) Manpower planning
(v) International collaboration and antarctic programmes
(vi) Data collection and dissemination
(vii) Legal regime

The activities and responsibilities of each area are given below:

(i) Living Resources: Today in India fisheries form the most important activity and the expansion in future would involve (a) deep sea fishing (b) aquaculture and (c) development of seaweed resources. The Department will establish its link with all organisations and agencies involved in the explorations and exploitation of marine living resources. It will also provide the necessary guidelines so that the Department can act as a catalytic agent and as a coordinating agency to provide the best results in the exploitation of living resources.

(ii) Non-living resources: This Division will plan and execute (a) deep sea mining programme of polymetallic nodules (b) exploration and exploitation of placer deposits along the coastal areas and (c) extraction of renewable sources of energy from thermal difference in the water column, waves, tides, salinity difference, biomass conversion, etc.

(iii) Ship management: The arrival of new ships will create a heavy demand of manpower, facilities, infrastructure and services available in the country and considerable work is required to finalise the cruises and their implementation with an effective utilisation of manpower from different user organisations in the country. This Division will coordinate with the organisations or agencies and also with the shipyards which will be handling the repair, maintenance and dry-docking. These are impossible without the creation of a division of ships. In addition to managing the proposed research vessels, there is also a considerable overriding work related to the chartering of the vessels for the completion of programmes in hand. There is, at present, no mechanism to handle this type of work by the Department effectively. There is also an additional responsibility for the Department to ensure that the work done during the cruises is processed, the data collected are analysed and given a final shape in the form of cruise reports. The new division must look after all these aspects.

(iv) Manpower planning: The most crucial factor in the entire developmental work of the marine sector is the availability of trained manpower. The department had made a rough assessment about the existing manpower to go on board the ship and collected the

required data and information from ship-board. It is clear from such a study that the trained manpower will have to be substantially increased. This has to be done through the Universities, IITs and other educational institutions since field-work training on shipboard will have to be organised by such institutions which have research vessels (NIO, GSI, ONGC) and the work will be coordinated by DOD.

(v) **International collaboration and Antarctic programmes :** There are several UN agencies which have active interests in the oceans. These are : Intergovernmental Oceanographic Commission (IOC) of UNESCO, FAO, UNEP, WMO etc. As a follow up of the Conference on the Law of the Sea, there are other agencies to be created. In addition to these, there are different bilateral agreements which are related to development of fisheries, ocean sciences, marine technology, pollution control, etc. The new division will be able to advise the Department on various matters related to foreign cllllaboration including the various types of programmes for providing assistance to India. It should also be able to handle the Antarctica project and its various implications, (scientific, economic, political and legal) effectively and advise the Department accordingly.

(vi) **Data collection and dissemination :** Research and development in ocean sciences are being handled by several agencies within the country. Similarly, surveys in the oceans are being undertaken by many agencies, The data collected by these agencies and the data obtained from outside the country require storage, retrieval and dissemination in a systematic manner to build information services.

(vii) **Legal regime** : An integrated legal framework will be necessary for the protection of the ocean environment and conservation of ocean resources. Some legislation has already been developed for regulating the fisheries and for controlling some of the activities in the maritime zone. However, an overall structure of the legal regime will have to be created for suitably regulating the intensified activities in the maritime sector.

(B) Work Plan of the Department

One of the first tasks undertaken by the Department was to prepare a profile embodying the future work plan for the marine sector. The Department, therefore, decided to organise a series of workshops (six in all) on various aspects of ocean development. Leading scientists, technologists, academicians and administrators participated in these workshops. The details of the workshops are as follows :

(i) **Manpower requirement, education, training and research facilities :** This workshop was held at the Andhra University, Waltair in October 1981. The theme paper was presented by Professor P.V. Indiresan, Director, IIT, Madras.

(ii) **Exploration and exploitation of seabed minerals :** In this workshop held at the National Institute of Oceanography, Goa during October 17-19, 1981, a state-of-the-art report was presented by NIO scientists.

(iii) Ocean engineering: A key paper was presented by Dr B.U. Nayak in this workshop held at NIO, Goa in October, 1981.

(iv) Marine instrumentation: Dr. E.D'sa of National Institute of Oceanography presented the theme paper in a workshop on this subject in October 1981.

(v) Ocean data management: This workshop was also held at NIO, Goa. The theme paper was presented in October 1981 by Shri R.M.S. Bhargava.

(vi) Ships and submersibles—their requirement and base facilities: The workshop on this subject was held at Jadavpur University, Calcutta, in November 1981. The theme was discussed under the following five headings :—

(a) Ocean mining
(b) Oceanographic research vessels
(c) Submersibles
(d) Support bases
(e) Ship research and ocean engineering centre

(C) Ocean Policy

After the completion of the workshops, the Department finalized a document entitled "Ocean Policy Statement" which was placed and discussed in both the Houses of the Parliament. The full text of this document is as follows :

1. The oceans are known to be our last frontiers. Our long coast and the sense of adventure of our ancients fostered a great maritime tradition. The Indian Ocean which washes our shores provided opportunities which need to be utilised. For success in ocean development, the entire nation should be permeated by the frontiers of knowledge. Our experience in other fields of scientific endeavour will help our efforts in ocean development the entire nation should be permeated by the spirit of enterprise and the desire to explore the frontiers of knowledge. Our experience in other fields of scientific endeavour will help our efforts in ocean development. What is necessary is a policy and structure to facilitate a dynamic thrust keeping in view the developments in other parts of the world.

2. The adoption, by an overwhelming majority of nations of the Convention of the UN Conference on the Law of the Seas has established a new international order for the oceans. This extends the economic jurisdiction of coastal states to an area ranging from 200 to 350 miles from the coastline. According to this regime, nearly 2 million square kilometres of area, or very nearly two-thirds of the landmass has come under India's national jurisdiction. In this area, the exclusive right to utilise living and non-living resources vests with the nation. Besides, India has been recognised as a "Pioneer Investor" in ocean mining. This gives India the exclusive right to operate in an area of up to 150 thousand square kilometers in the high seas for the recovery and processing of polymetallic nodules.

3. For ages, the sea has enabled our people to sail to near and distant lands and has been a source of livelihood to large numbers of people. Even now Indian public and private enterprises do use ocean resources. The country is producing significant quantities of fish and hydrocarbons from the sea and much scientific work has been done in collecting basic knowledge and information about the sea and seabed and in surveying, charting and exploiting it. Progress has also been made in the construction and development of offshore structures.

4. The vastness, complexity and uncertainty of the ocean environment calls for a coordinated, centralised and highly sophisticated development response. This should be based on adequate knowledge of marine space (seabed, water and air columns included) as a fundamental prerequisite to the control, management and utilisation of the rich and varied natural resources, available in the sea. In addition to basic knowledge to determine the potentialities inherent in the Indian sea-space, we have to develop appropriate technologies to harness these resources. A supporting infrastructure has to be built. Effective systems of management and control of the entire set-up are also necessary.

5. We need to map living resources, prepare an inventory of commercially exploitable fauna and to map and assess the availability of minerals from the deep sea. The supporting infrastructure and incentives required are research vessels of different types, manpower, well-laid out programmes of resources exploitation, advanced technology and everything necessary to promote the growth of ocean technology. In the management sector, the high seas and the Exclusive Economic Zone (EEZ) up to 320 kilometers have to be looked into for the exploitation of the wealth occurring therein.

6. The main thrust should be on the optimal utilisation of living resources like fish and seaweeds, exploitation of non-living resources such as hydrocarbons and heavy placer deposits, harnessing of renewable resource of ocean energy from waves, temperature difference in the water column, tidal heights and salinity gradients and the collection and processing of polymetallic nodules from the deep sea.

7. Marine development is linked with scientific and technological achievements in other areas. Hence while we develop the basic marine science and technology, i.e. technology for marine environment, our technological advances have to be geared to the utilization and preservation of the marine environment. The extension of national frontiers by an area of 2 million square kilometres of ocean space and the consequent access to new sources of energy, minerals and food, requires great strides in ocean engineering, specially in tasks related to structures, materials, instrumentation, submersibles and systems of propulsion of ships. The exploitation of natural food resources such as fish and seaweeds, and the generation of additional food resources by cultivation, also need scientific methods of aquaculture and mariculture. To survey and predict the ocean environment, the main tasks necessary are seafloor mapping, charting, geodesy, ocean dynamics, currents, waves, cyclones, marine fauna, chemistry and physics of the ocean and seabed mineral mapping, delineation and assessment. Research in all these areas must examine the various processes and their origins so as to

have a fundamental understanding, ensuring predictive capabilities. Marine science and technology has also to look beyond the current state-of-the-art to achieve major technological breakthrough in the future.

8. Besides research and development in basic sciences, we should survey the deeper part of the ocean. Similarly in the deep sea, detailed surveys and sampling in the regions of EEZ and the adjacent ocean will be necessary to locate and evaluate the rich and economically viable deposits of polymetallic nodules, heavy metals, fossil placers and phosphorite deposits. The gathering of data from surveys should be coordinated and a cost effective system of integrated surveys established.

9. Much more needs to be done for the development of indigenous technology for the exploitation of fish from deeper waters. This also means setting up of infrastructure facilities and services to operate large-sized fishing vessels.

10. An important component of the development programme should be the acquisition of technology. To be self-reliant, such technologies would have to be largely developed, tested and operated indigenously. Technologies relating to instrumentation, diving systems, position fixing and position maintenance. materials development, oceanic data collecting devices, anti-erosion capabilities, submersibles,energy and energy-saving devices are priority items. Several new technologies will have to be commercialised and made cost-effective.

11. Infrastructura support forms an essential prerequisite for ocean development. The variegated infrastructure already available in the country will have to be approapriately augmented, and more particularly in basic supporting facilities like safety and rescue at sea, navigational chains, communication networks, development of appropriate maps and charts, etc. Infrastructural support for providing a complete and reliable information system through a network of data centres on marine resources, processing and marketing systems, advanced technologies and financial assistance would also be necessary. This requires a broadening and strengthening of available infrastructural facilities. Provisions of adequate ports and harbours, ship-building and ship-repair facilities will be needed in addition to adequate skilled manpower in various sectors of development.

12. Surveillance and conservation of the marine environment and its resources call for an integrated legal framework and its concomitant enfroncement. Several laws have already been promulgated regarding the maritime zone, fisheries, etc. The Coast Guard Organisation looks after the enforcement aspects of several of these legislative measures. The coordinating mechanisms of the overall structure of legislation will have to be suitably strengthened under the aegis of the Department of Ocean Development.

13. In the light of this we must have a data base to coordinate the efforts made by different agencies. This is all the more necessary because of the rapid growth of information in ocean science and technology. A centralised data system will be set up by the Department of Ocean Development with a proper mechanism for the collection, collation and dissemination of information acquired both indigenously and from foreign sources.

14. The creation of a self-reliant technological base puts a heavy demand on fully trained personnel. The training of skilled manpower is to be adequately planned. Young scientists, technologists and engineers will be encouraged to participate in the programme of ocean development and steps will be taken to induce Indian scientists from within the country and abroad to participate in it.

15. Existing agencies will have to be appropriately strengthened to meet the demands of this growing challenge. The Department of Ocean Development will function in conjunction with the other concerned agencies as a focal point to promote institutional capability in areas where significant work is lacking. The complex programme that ocean development entails will require well-designed management and institutional extension of the Department of Ocean Development with sufficient powers vis-a-vis other agencies to help proper and speedy ocean development, which enables India to be in the forefront of the international effort. This would also mean close cooperation with both developing and developed countries in a spirit of understanding of the concept that the oceans are a common heritage of humankind.

3. ANTARCTIC RESEARCH PROGRAMME

The possibility of sending a scientific expedition which combines the deep sea exploration and the study of living and non-living resources in the Indian Ocean and the Antarctic region (an area which is divided from our country only by a few islands and a continuous stretch of water of the Indian Ocean) has been under consideration for some time. After looking into the various implications of such a project, the Department of Ocean Development decided that it would be useful from a scientific point of view to send a scientific expedition as it would add to our knowledge of factors relating to the Indian Ocean and the monsoon phenomenon on which the economy of the country is critically dependent. In addition, there may also be several other advantages in the evaluation of several aspects of life in the ice-bound regions which are akin to areas on our northern frontiers. It would also help in taking concrete steps for environmental protection in our surrounding ocean areas as well as in other linked surroundings.

The ice sheet in Antarctica originated perhaps more than 50 million years ago and has continued since then, completely undisturbed by melt/freeze phenomena which occur, for example in the Himalayan glaciers and lead to physical disruptions. This Antarctic ice, therefore, acts as an extremely well preserved repository of all things falling on it and buried in it such as fragments of cosmic bodies, nuclear products of cosmic rays, samples of entrapped air and minerals. Scientists from the world over have been experimenting to study and decipher these signals which undoubtedly provide records of global and cosmic changes over the past millions.

The glacial history and the past climatic changes being studied at present from the Himalayan ice samples and glaciers, etc. are inextricably mixed with the effects of the spasmodic uplift (of thousands of metres) that these mountains had experienced. The Antarctica, which represents a stable situation affected only by global climate offers us a reference standard to separate the two sets of information and to refine the information about each set individually—a matter of great scientific importance to us.

Studies on the mass balance of annual glacier are at present providing us data about the current short-term climatic fluctuations in the Himalayas. Linking this to the annual changes on the largest freeze-melt operation on earth i.e. in the sea regions of Antarctica is bound to yield important scientific insights into the global weather phenomenon, its changes and its effects on our environment.

A study of the Antarctic waters, apart from the immense scientific interest it provides, would also be of much economic value. For example, it is known that the whale-stocks have become seriously depleted and many countries feel that further studies on the conservation of the Antarctic ecosystem are of great importance to the future of mankind. The meteorological conditions of the area and their influence on the physics, chemistry

and biology of this area including the formation of the Antarctic bottom waters are of very much scientific and economic interest. Antarctica is crucial to global weather phenomena — the air circulation patterns, the cold phases (glacial and interglacial periods) and the sea currents. It, therefore, invites a study of its physical parameters like the radiation balance, water balance, temperature-induced phenomena, etc.

Many other countries have been exploring the Antarctic landmass and the surrounding seas for several decades. Many Indian scientists participated in the International Indian Ocean Expedition (IIOE; 1959–65); 20 countries and 46 ships took part in IIOE which was initiated by a Scientific Committee on Oceanic Research(SCOR) and conducted by the Intergovernmental Oceanographic Commission of UNESCO. This expedition covered the Indian Ocean, Red Sea, Persian Gulf and the adjacent areas extending southward up to the Southern Ocean; but did not go beyond 40 degree south.

Indian science has now developed enough expertise and experience in various branches of geology, geophysics, oceanography, meteorology, astrophysics, space science and communication science to take up a detailed scientific study on the landmass of Antarctica and oceanographic studies in the surrounding seas.

Keeping this in view, the Department of Ocean Development organised two scientific expeditions to the South Indian Ocean and Antarctica during 1981-82 and 1982-83.

A. First Indian Expedition to Antarctica

Many oceanographic processes in the Indian Ocean are governed by the Antarctic Ocean, which in turn, affect our coastal seas considerably. The two scientific expeditions to the Antarctic waters were organised entirely as a national effort. In the first expedition, the Council of Scientific and Industrial Reasearch was selected as the lead organisation with National Institute of Oceanography as the coordinating agency for the expedition. The second expedition was coordinated entirely by the Department itself.

For the first expedition, the programme was mooted in July/August, 1981 and the Department initiated action to organise the expedition on a priority basis.

The main objectives of the first expedition were :

1. To initiate studies, build facilities and expertise in different oceanographic disciplines. disciplines.
2. To continue and strengthen programme of routine data collection and studies.
3. To identify scientific programmes of significance to the Indian context in scientific and economic terms and pursue these as thrust areas to establish a position of Indian science in this sector.
4. To set up a base of operation on Antarctica.

The major task before the Department was to acquire a suitable vessel (ice-breaker) and the necessary equipment for this expedition. After careful consideration a

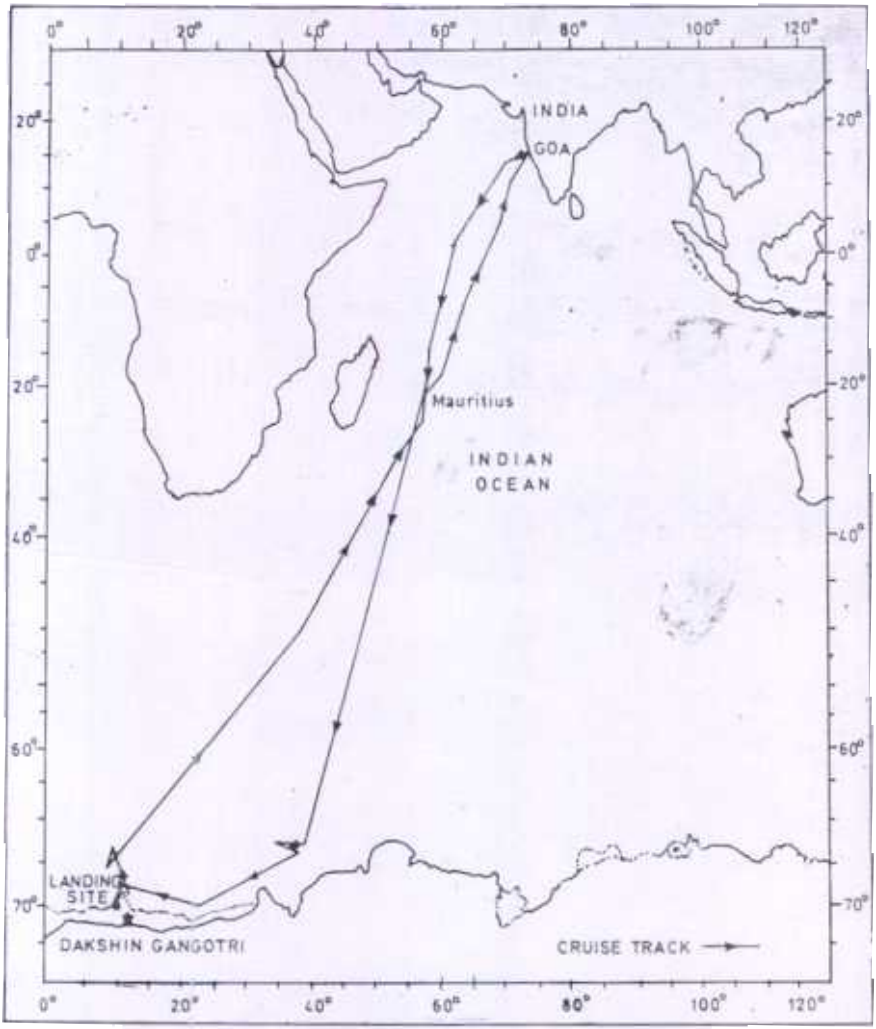


Fig. 1 Cruise track of the First Indian Expedition to Antarctica

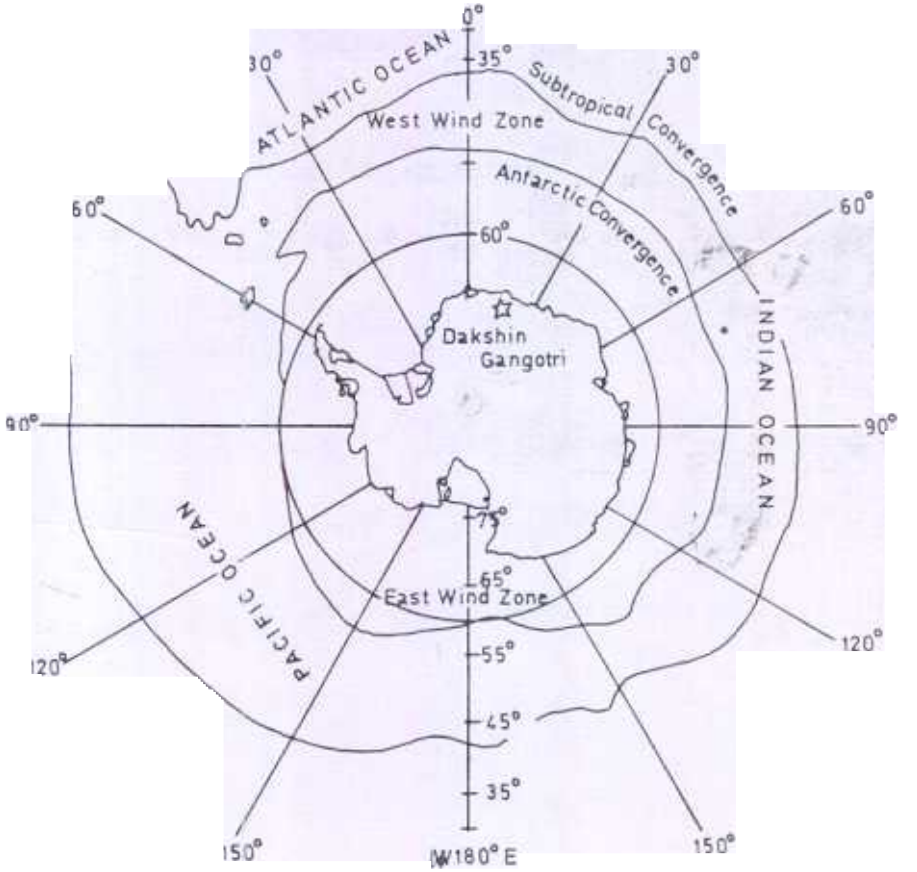


Fig. 2 Location of the Indian Station—Dakshin Gangotri—at Antarctica.

Norwegian Vessel *Polar Circle* from M/s. G.E. Reiber & Co. Bergen was chartered. The excellent earlier record of the ship in Antarctica, space and facilities available on board, prompted the selection. Photo of *Polar Circle* and few main specifications such as length, breadth, draught, tonnage, endurance, accommodation for living and work are given in a tabular form.

The Department lost no time in acquiring all the equipment to equip the vessel. These included snow scooters, position fixing equipment, bathythermograph, side scan sonar, seismic profiler, echosounders, etc.

All the equipment with the support and cooperation of various Ministries and Departments were purchased and procured in record time. Logistic support was provided by the Indian Navy. At the same time, a team of dedicated scientists from the following organisations was selected :

Department of Environment (DOEn)

National Institute of Oceanography (NIO)

lian Navy (IN)

4. Geological Survey of India (GSI)

5. India Meteorological Department (IMD)

Institute of Geomagnetism (IIG)

Natic ial Physical Laboratory (NPL)

The fol wing were the members of the team of the first expedition

Dr S.Z. Qasim	Leader	Department of Environment
Shri C.P. Vohra	Dy Leader	Geological Survey of India
Shri H.N. Siddiquie	Dy Leader	National Institute of Oceanography
Dr R. Sengupta	Membei	National Institute of Oceanography
Dr A.H. Parulekar	Member	National Institute of Oceanography
Dr E. D'sa	Member	National Institute of Oceanography
Shri M. Pathak	Membe	National Institute of Oceanography

8.	Shri D.V. Ramaraju	Member	National Institute of Oceanography
9.	Shri S.G. Prabhu Matondkar	Member	National Institute of Oceanography
10.	Dr A. Sengupta	Member	National Physical Laboratory.
11.	Cdr D.S. Brar	Member	Indian Navy
12.	Surg. Cdr S.J. Thomas	Member	Indian Navy
13.	Lt Cdr K.D.S. Sandhu	Member	Indian Navy
14.	Lt Cdr K.S. Sarma	Member	Indian Navy
15.	Lt Cdr K. Chandani	Member	Indian Navy
16.	Cheaa. M.R. Mahapatra	Member	Indian Navy
17.	Chaa. G.V. Shirsat	Member	Indian Navy
18.	Poma J.S. Saini	Member	Indian Navy
19.	Shri A.K. Sharma	Member	India Meteorological Department
20.	Shri K.N. Katyal	Member	India Meteorological Department
21	Shri R.V. Iyengar	Member	Indian Institute of Geomagnetism

The participants were preacclimated to cold in a vigorous training programme at the High Altitude Warfare Institute, Gulmarg, and on board a Naval ship for sea acclimatization. The entire team was briefed by several top scientists of the country from different angles.

With the necessary preparation, the team assembled at Goa where the chartered ship MV *Polar Circle* arrived in late November of 1981. After the necessary formalities of loading the essential equipment, stores and accessories, the ship sailed on its voyage on 6th December, 1981 from Marmagao Harbour, Goa.

The team, after a very successful cruise, landed on Antarctica on 9th Jan. 1982. It was considered an important landmark in Indian science. The Prime Minister herself sent a message of greetings to the team while it was still in Antarctica. The expedition after a stay of 10 days on the frozen continent returned on 22 Feb. 1982.

The Indian Posts & Telegraphs Department issued a special stamp on 9 January, 1983 to commemorate the landing of the First Indian Scientific Team on Antarctica. The stamp designed by the P&T Department was based on a photograph showing the Indian scientists in their camps in Antarctica. The first day cover design comprises a collection of photographs showing different activities of the expedition along with a map of Antarctica.

Summary of the Scientific Work Carried Out During the First Expedition to Antarctica

1. Meteorology

(a) On the way to Antarctica, the Indian team made a variety of observations and collected valuable data on atmospheric temperature, pressure, windspeed, humidity surface ozone, cloud visibility and radiation. Many of these parameters were measured at 3 or 6 hourly intervals.

(b) Thirty three radio-sonde balloons equipped with radio transmitters and sensors to record the atmospheric pressure, temperature and humidity were released. These balloons covered the upper atmosphere up to 20-25 km height.

(c) Five radiometre-sonde balloons were also launched. In addition to measuring the atmospheric pressure, temperature and humidity, these balloons also measured radiation balance (i.e. how much radiation is reflected back into space and how much passes through the atmosphere).

(d) The team, during its stay in Antarctica, launched a total of 14 radio-sonde flights to measure precipitation, albedo (the amount of light reflected) of the snow cover, temperature and humidity.

(e) An unmanned weather station was set up in Antarctica to measure windspeed, wind direction, air temperature, humidity and casing temperature. A snow-cum-rain gauge for measuring snowfall has also been left behind. The weather station is solar powered, and during the winter months, when there will be no sunlight, fully charged heavy-duty batteries will be available to provide power to the computer which will record the data on cassette which can be recovered later.

2. Radiowave propagation studies

Four different areas of work in these studies were covered as follows

(a) *Very low frequency (VL) propagation studies:* These consisted of a measuring phase of amplitude of wireless signals transmitted by two OMEGA navigation transmitters.

(b) *High frequency (HF) propagation time delay:* HF standard time signals were measured during the cruise. For this, a synchronised atomic clock was kept running on board the ship.

(c) *Measurement of high frequency (HF) radio noise level:* This experiment was conducted for measuring the ambient HF radio noise level over the frequency range 10 KHz to 30,000 KHz using a calibrated field intensity meter.

(d) *Communication experiments:* The results of these experiments indicate that radio communication in the Antarctica suffers from several problems. There are radio black-outs caused by the polar cap which lasts from a few hours to a few days. The non-

conducting ice cover makes the operation of antenna difficult. Non-directional beacon transmitters from the helicopter operations were also found difficult to set up.

3. Glaciology

Ice samples, ice cores and ice crystals were collected from the ice-shelf and studies were conducted on the melting rate of ice as well as on the radiation falling over the ice for 24- hour periods.

4. Magnetic measurements

The studies during the expedition can be subdivided into two parts:—

(i) Magnetic studies in ocean, and

(ii) Magnetic studies on the Antarctic continent.

Magnetic studies in the ocean were carried out using a marine proton magnetometer with a towed sensor. On the whole, 20,000 line kilometres of megnetic data were collected from the sea. In magnetic studies on land, a proton magnetometer was used for recording the total field continuously. A fluxgate magnetometer to record the field components continuously was used and a digital component fluxgate was used to make on the spot abservations, so that the sensitivity of the fluxgate could and derived and verified.

5. Aerosol measurements

Forty samples of Aerosol were collected during the cruise by running an indigenously fabricated sampler. These measurements will give an insight into the pollution levels in the oceanic areas between Goa and Antarctica.

6. Geology

Rock samples were collected in Antarctica from the out-crops. Dust and debris from within the ice-layers were also collected for petrological and geochemical studies. Some significant observations were made on pack-ice, bay-ice and ice-shelf.

7. Oceanic studies

(a) A continuous temperature profile up to 70 metre depth was taken between Goa and Antarctica, which enables to understand the energy transfer mechanism.

(a) Seismic profiling of the ocean-bed was carried out.

(c) A productivity survey of the Indian Ocean and the Antarctic waters was accomplished.

(d) Distribution of chlorophyll-bearing plankton was studied to assess the primary productivity of Antarctic waters.

(e) Benthic studies were carried out on the bottom sediments (sea-floor) to evaluate

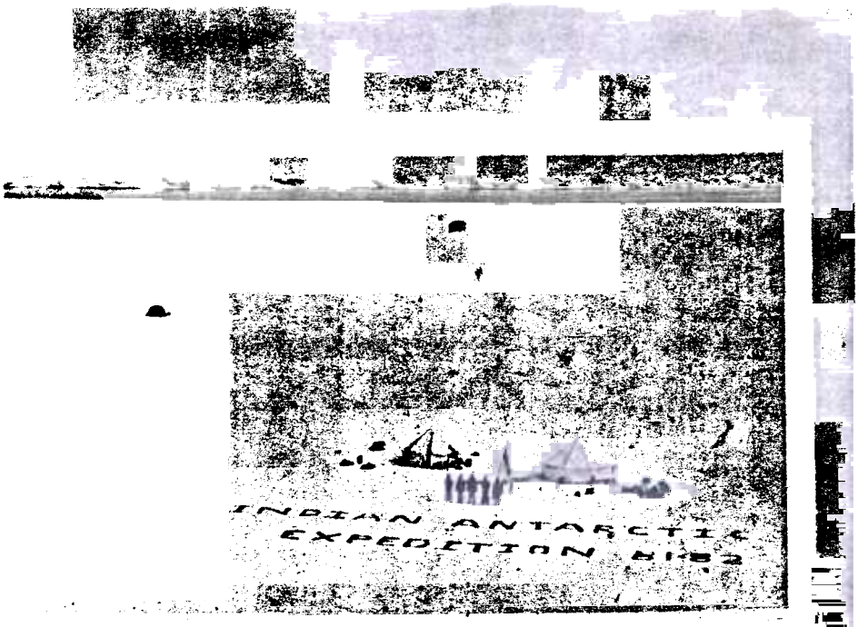


Fig. 5 Indian Antarctic Expedition 1981–82 written on ice with red dye next to the base camp.

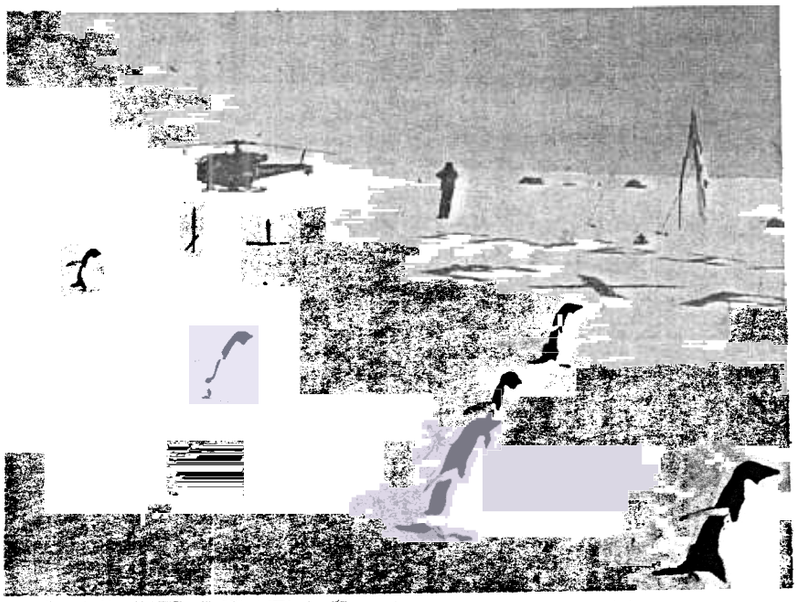


Fig. 6 A flock of penguins near the Indian base camp at Antarctica.

the qualitative and quantitative aspects of life.

(f) Several hundred water samples were collected for chemical analysis of dissolved oxygen, phosphorus, nitrogen and silicate-silicon. Nearly 500 samples of sea water were collected for the analysis of calcium, magnesium, sulphate, fluoride, bromide and iodide.

(g) Samples for the study of physical aspects of the Southern Ocean were collected from many stations. Salinity and temperatures at different depths were recorded. The data when processed, will help in the determination of Antarctic convergence and divergence.

8. Chemistry and biology of shelf-ice

Experiments were conducted for assessing the magnitude and rate of production of organic matter in the shelf-ice. Ice samples were also collected up to a distance of approximately 20 km from the edge of the shelf-ice for the analysis of the nutrient content of ice.

9. Collection of living organisms from Antarctica rocks

Several samples of primitive vegetation such as mosses and lichens from the rock crevices were collected for further investigation.

B. Second Indian Expedition to Antarctica

During the year, after the successful completion of the first expedition, the Department organised a second expedition to Antarctica which successfully landed on the frozen continent on 28 Dec. 1982. The objectives of the second expedition were as follows :

I. Logistics

(a) The stay on Antarctica during the first expedition was for a total duration of 10 days. This was too short a duration for carrying out useful scientific research on land. The second expedition will stay on the landmass Antarctica for a period of 60 days.

(b) It will survey the area and select a site for setting up a permanent-manned station on Antarctica. It will set up a base camp on this site which should be on the landmass, at least 60 km away from the ice shelf. It will recover the cassette from the automatic weather recording equipment left behind during the first expedition.

(c) It will work out the logistics for setting up and servicing a permanently-manned research station on Antarctica. For this purpose, it will carry out a detailed assessment of the annual requirements of manpower, stores, equipment and services for the permanently- manned station to be operative during 1985-86 season.

(d) It will survey and identify a suitable air strip and prepare it for landing of an aircraft.

(e) It will establish a direct communications link between the base camp on Antarctica

and India as also between the base camp and the mobile parties on the land mass and the ship.

II. Scientific

(1) Environment : It will continue the work on the collection of aerosol so as to make Antarctica a reference point for judging the levels of pollution in India and in other countries bordering the Indian Ocean.

(2) Living and non-living resources : It will carry out studies on krill and will also conduct geological and geophysical surveys on the mainland for mineralogy.

(3) Meteorology : It will collect continuous data for about 60 days on the atmospheric temperature, pressure, windspeed humidity, surface ozone, cloud visibility and radiation. A small meteorological observatory will be set up for the collection of weather data from where regular radio-sonde and radiometer-sonde baloon flights will be conducted. Regular weather forecasts and ice charts released periodically from other manned stations on Antarctica will also be obtained.

(4) Atmospheric physics and radio transmission studies : During the last expedition, little work could be done on atmospheric physics due to shortage of time. In the second expedition, more instruments of the right tape have been taken to measure solar radiation, stratospheric temperature, total magnetic intensity over a period of time. Continuous records of different types of radio wave propagation for a much longer period will be made to support the findings obtained during the last expedition. The collection of data on the radio wave propagation from different locations of Antarctica would be most valuable.

(5) Land and ice geology : In the first expedition, only rock and ice samples could be collected in limited quantities without making any on the spot examination and selection. These samples will give only a preliminary idea of the geological features of the landing station. Experienced land geologists have been sent in the second expedition to collect representative samples of rocks and cores from the landmass. These samples will provide information on the most valuable history of Gondwanaland. Rock and core samples will be from several places and particularly from the area where manned Indian station is being planned.

(6) Minerology and other investigations to throw light on the ancient life of Antarctica : t has been shown by earlier studies that life appeared on Antarctic as early as anywhere else in the world. Records, thereafter, from Antarctica show a mighty succession of plant life leading to contemporary forest trees. Fossil records show that in the early history, Antarctica was as hospitable to animal life as any other continent. Fossils do occur in Antarctic rocks although these are not very common. They are most valuable and give a wealth of information regarding the early history and life of Antarctica. In fact, from these, the missing links in the chain of events recorded in other parts of the world including India could be found. The second expedition will make a study of the fossils and hopefully will collect some.

(7) Bacteriology : The microbial problems in the Antarctic are not very well known. The setting up of a permanent station will call for the study of microbes involved in the

a being introduced to the Prime Minister

Fig. 8 Team of First Antarctica Expedition with Prime Minisfer

complex process of human adaptation to extreme environmental conditions of Antarctica.

(8) Human-environment relationship in terms of adaptation: Human being rapidly adapt themselves to external environmental conditions by undergoing certain inherent changes in their metabolism. Some of these should be studied among the participants of the team as some persons will adapt themselves to climatic changes much faster than others.

(9) Special medical services while living in Antarctica: It is well known that climatic conditions in Antarctica are far more severe than anywhere else in the world. Extreme low temperature, strong winds, low atmospheric pressure, sharp fluctuation in radiation (polar night any day), insular state, abiotic landscape, reversal sequence of seasons from the northern hemisphere and several other factors create severe conditions for human life and activities in Antarctica. Under these conditions, the medical facilities that are going to be associated with a manned-station demand special significance.

(10) Study of terrestrial life of Antarctica: Antarctica is known for its primitive form of life such as mosses, snow algae (green and brown), yellow crustaceous lichen, orange crustaceous lichen grass (which is one of the three flowering plants present there), blue green algae, etc. Among the animals, wingless fly, free-living mites, springtails and several microscopic animals are found. These should be collected and brought for further studies. Moreover, observations on larger animals like penguins, seals, etc. should be made in great details and bird life should be identified properly.

(11) Full description of the explored area: In the second expedition, it would be necessary to describe the entire explored area in terms of its flatness, steepness, proximity to rocks, mountain area and ice covered valleys. Its geographical position, therefore, should be accurately determined and survey sheets showing the demarcated area with details should be prepared.

It is proposed to set up a manned station at Antarctica by the year 1985-86 to have a continuous scientific observations all the year around.

members of the team of the second expedition

1	Shri V.K. Raina	Leader	Geological Survey of India
2.	Shri C.R. Sridharan	Dy Leader	India Meteorological Department
3.	Shri M.K. Kaul	Member	Geological Survey of India
4.	Shri S.K. Chakravarty	Member	Geological Survey of India
5.	Dr. A. Sengupta	Member	National Physical Laboratory
6.	Shri P.K. Pasricha	Member	National Physical Laboratory
7	Shri A.K. Sharma	Member	India Meteorological Department
8.	Shri L.A. D'cruz	Member	Indian Institute of Geomagnetism

9	Shri G.S. Mitta	Member	National Geophysical Research Institute
10.	Shri H.R.S. Sastry	Member	Naval Physical & Oceanographic Laboratory
11	Shri Prabhu Matondkar	Member	National Institute of Oceanography
12	Shri D.R. Haldankar	Member	Films Division/Ministry of Information and Broadcasting
13.	Lt Cdr R.S. Gill	Member	Indian Navy
14.	(01120-W)		
14.	Lt Cdr K.S. Randhawa (01189-A)	Member	Indian Navy
15.	Lt Cdr Kulwant Singh. (01219-W)	Member	Indian Navy
16.	Lt Cdr R. Sethi (01232-N)	Member	Indian Navy
17.	Lt Ujjal Singh (86022-B)	Member	Indian Nav
18.	Shri I. Khan (Ch ELA) (094344-W)	Member	Indian Navy
19.	Shri P.K. Kapoor (POELAR) (097141-A)	Member	Indian Navy
20.	Surg. Lt. Cdr. D.B.Rao (75157-K)	Membe	Indian Navy
21	Sqn Ldr. H.N. Chaturvedi (11161	Member	Indian Air Force
22.	Major D.J. Singh	Member	Indian Army
23.	Major Jai Bahuguna	Member	Indian Army
24.	Major P.K. Nair.	Member	Indian Army
25.	Wg. Cdr. Abhay Singh (8424) F(P)	Member	Indian Air Force
26.	Sqn. Ldr. R.S. Tondon (9432) F(P)	Member	Indian Air Force
27.	Shri B.S. Thakur (AM3) (093474-T)	Member	Indian Navy
28.	Shri Anant Kumar Andhare	Member	Bharat Electronics Ltd

Fig. 9 Prime Minister presenting plaque to the leader of the team.

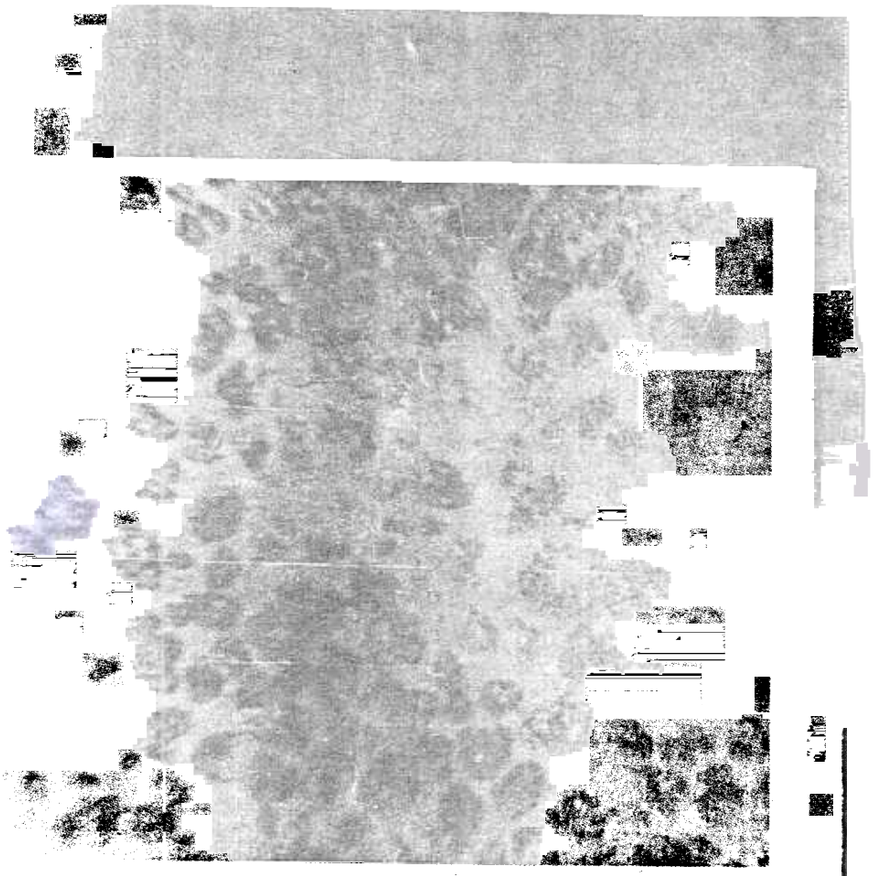


Fig. 10 Polymetallic nodules on the sea-floor of the Indian Ocean. Photograph taken by a underwater camera at 5000 m depth.

4. EXPLORATION OF POLYMETALLIC NODULES IN THE INDIAN OCEAN

The scarcity of metals like copper, cobalt and nickel on land has prompted many countries to explore the mineral potential of the oceans, and after many years of exploration it became clear that the oceans have abundant supply of these metals in the form of nodules. Besides iron and manganese, the nodules contain many other metals such as copper, cobalt and nickel. These are estimated to cover an area ranging from 10–15 million km^2 in the Indian Ocean as against an area of 46 million km^2 in all the oceans. the nodules generally occur between 3500 and 6000 m depth in all the ocean basins.

The National Institute of Oceanography, Goa had initiated a R&D Project on polymetallic nodules in 1977. The first sample was collected by the Indian Research Vessel *Gaveshani* from the Western Indian Ocean in 1980. The Department of Ocean Development vigorously pursued the exploration of polymetallic nodules in the Indian Ocean.

On 30 April, 1982, the Third U.N. Conference on the Law of the Sea adopted a Convention and Resolution on preparatory investments in pioneering activities relating to polymetallic nodules. According to this Resolution, four countries namely India, France, Japan and U.S.S.R. and four multinational consortia (Kennecott group with 5 mining companies, Ocean Mining Associates with 3 companies, Ocean Management Inc. with 4 companies and Ocean Mineral Company with 5 companies) all headed by U.S. were recognized as "Pioneer Investors". Each Pioneer Investor by definition is expected to sign the Convention stating that prior to 1 January, 1983, the investor has expended an amount no less than U.S. $ 30 million in pioneering activities of deep sea mining and has expended no less than 10 per cent of that amount in the location, survey and evaluation of a specific mining site. The site should be large enough to be later divided into two pioneer areas of equal estimated commercial value. The size of one pioneer area should not exceed 150,000 sq.km.

This development will accelerate the preparatory work connected with deep sea mining. However, the technology for carrying out deep sea mining today is only with a few countries. No country has yet demonstrated a properly evaluated and economically viable system for mining of polymetallic nodules.

The project will have two phases :

Phase I
Location of mine site through regional survey.

The objective will be to collect data on :

1. Station location
2. Abundance data
3. Analytical information
4. Geological information
5. Geotechnical information
6. Oceanographic data
7. Meteorological data
8. Ecological data

Phase II

This will be initiated in an area identified as prospective mine site in phase I operation. Operationally, all the eight elements of the matrix will be collected in selective areas. This phase will be integrated with the programme of mining system development and actual pilot operation of mining.

Activities :

The first target was the Central Indian Ocean and DOD has entrusted the work to the Council of Scientific & Industrial Research— one of whose laboratories— the National Institute of Oceanography has considerable expertise to undertake the task.

Based on the programme, the phase I work was first initiated with National Institute of Oceanography's research Vessel *Gaveshani* in the Central Indian Ocean. However, because of its limited endurance the DOD decided to charter additional ships. Accordingly, two ships, MV *Skandi Surveyor* from Norway and *MV Furnella* from UK have been chartered and these were deployed for the first phase of this project in the Central Indian Ocean. The survey activity so far has progressed well. To date *R.V. Gaveshani* has made 3 cruises, *MV Skandi Surveyor* 4 cruises and MV *Furnella* 2 cruises. Already an area of 2.6 million km^2 has been surveyed and 1.0 million km^2 area was found to be covered with nodules. The highest abundance of 21 kg/m^2 has been observed. The survey will progressively identify the coordinates of the mine site.

On the completion of phase I, Phase II will start which will include the collection of data for designing and selecting appropriate mining systems. This phase will include :

(i) development of new techniques for exploration.
(ii) conceptional model for future exploration
(iii) mineralogy, chemistry and geneology of nodules
(iv) geology, geological history and structure of the ocean basin

Under the phase II programme, besides National Institute of Oceanography, othe institutions involved will be :

Geological Survey of India, Calcutta;
National Geophysical Research Institute, Hyderabad;
Regional Research Laboratory, Jamshedpur;
Bhabha Atomic Research Centre, Bombay;
Hindustan Zinc Ltd., Udaipur;
Hindustan Copper Ltd., and
Indian Bureau of Mines, Nagpur; etc.

Arrangements have been made to airlift the samples from the National Institute c Oceanography, Goa to each of these laboratories who will send back the analytical dat back to National Institute of Oceanography for screening and making further inferences

The result of the surveys carried out till Aug. 1982 can be summarised as follows :

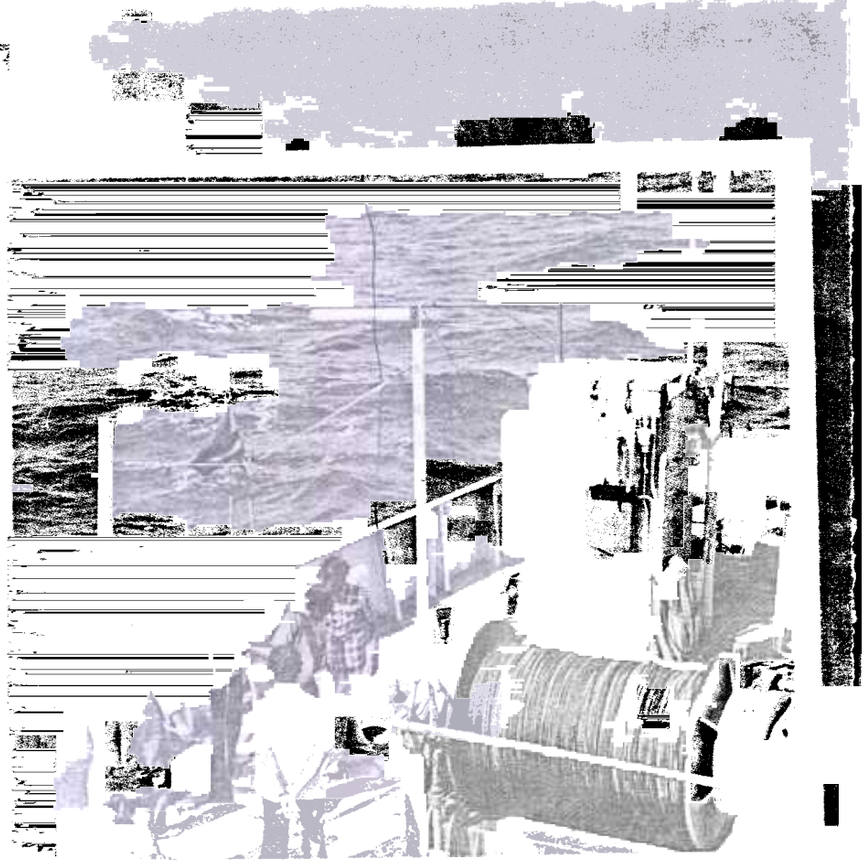
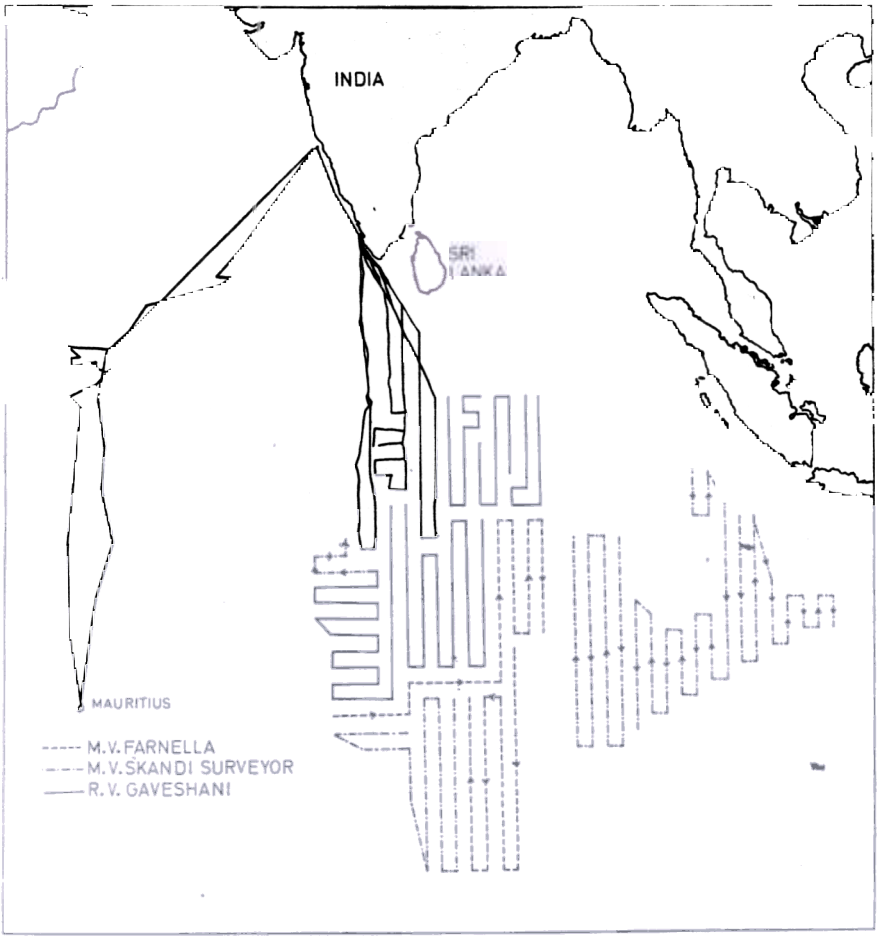


Fig. 11 Collection of polymetallic nodules by Boomerang Grab.



ruise track of the Survey **Polymetallic Nodules** the Indian Ocean.

Area surveyed in the Central Indian Ocean	2.6 million km^2
Area covered by nodules	1.0 million km^2
Stations covered:	
Boomerang and other grabs launched	710
Abundance noted at stations	190
Analysis carried out numbers	
Traces of nodules observed	
Abundance at stations of more than 5 kg/m^2	98
Highest abundance	21 kg/m^2
Echosounding	43,000 line km
Magnetic record	54,000 line km
Nodule abundance	10 kg/m^2 area 0.01 million km^2 5-10 kg/m^2 area 0.064 million km^2 1-5 kg/m^2 area 0.015 million km^2
Metal concentration	2% — 0.09 million km^2 2.47% — 0.07 million km^2 3% — 0.02 million km^2

On completion of the assigned task RV *Gaveshani* has been released in Jan. 1983 for the regular R&D programmes of National Institute of Oceanography, while the two chartered vessels *Skandi Surveyor* and *Farnella* are still engaged in the exploratory work in the Central Indian Ocean. The data are continuously coming and these are being processed.

5. ACQUISITION OF RESEARCH VESSELS

One of the most important prerequisites for oceanographic work is the availablity of suitable ships. Our country has, at present, only one ocean-going research vessel *Gaveshani,* which is being operated by CSIR/NIO. There are a few other vessels in the country used for specific purposes, but these are not equipped to carry out multi-disciplinary oceanography. With the fast expanding activities in the ocean sector, the Government of India decided to acquire most modern oceanographic research vessels for the country. Contract for one research vessel has already been completed, while for another vessel it will be completed in February-March 1983.

(i) Oceanographic Research Vessel *"Sagar Kanya"* **: In 1982 the Dapartment entered** into an agreement with the Government of West Germany to construct a new ship. This ship is being acquired under soft loan from the Federal Republic of Germany. The ship is nearing completion. It was launched in Sept. '82 and has been named *"Sagar Kanya".* The total cost of the ship is 62.05 million DM while scientific equipment worth about 18.4 million DM have been provided in the ship. This vessel is being built at Schilchting-Werft, Travemunde, FRG. The specifications of *"Sagar Kanya"* are as follows :

The ship having a displacement of 4000 tonnes and a maximum draught of 5.6 m is very versatile and safe to work. Some of the special features of this ship are :

1. 24 channel seismic system;
2. wind/weather surveillance radar system with 128 k memory computer;
3. an integrated satellite navigation system with 128 k computer;
4. a central electronic processing system with 256 k memory and two desk type computer each of 187 k capacity; all the computers will be linked for quick processing of data; and
5. a CTD-O_2 profile system for continuous monitoring of physical oceanographic parameters.

The ship will assist in carrying out researches in all disciplines of oceanography. The significant capability built into *Sagar Kanya* is for deep sea researches and for the survey of polymetallic nodules in the Indian Ocean. *Sagar Kanya* could also be used for guiding and assisting the future ocean mining vessels during pilot surveys or in their full scale operation.

Sagar Kanya is complete in all respects and trial cruises will start towards the end of February, 1983. The ship is expected to arrive in India in June, 1983. This will be the most sophisticated and highly advanced research vessel in the world.

(ii) Fisheries and Oceanogriphic Research Vessel (FORV) :
Another ship, Fisheries and Oceanographic Research Vessel (FORV) is being acquired

from Denmark on a loan from the Danish Government. The letter of interest for this vessel has been issued to the shipyard—Dannebrog, Vaerft of Denmark at an estimated cost of 141.56 million Danish Kr. This ship will mainly be used for locating living resources, assigning their extent and will be able to identify the spawning grounds of economically important fishes. It will also carry out work in other related disciplines of oceanography. According to the anticipated time schedule, the ship is likely to be delivered by **September, 1984.***

* Contract between Govt. of India and the Shipyard was signed on 4 March, 1983.

6. CHARTERING OF SHIPS

The Department has in hand two major projects namely (i) Antarctic Research and (ii) Exploration of Polymetallic Nodules. Both these projects require specially equipped ships. Since no such ships were available within the country, it was considered essential to charter them from abroad. In view of this, a global search was made and the following ships were chartered :

(1) **M.V. Polar Circle :** This is an ice-breaker and was chartered from M/s Reiber & Co. Bergen, Norway for the first expedition to Antarctica.

(2) **M.V. Skandi Surveyor :** The programme for the exploration of polymetallic nodules had been under constant review by the Department. This programme was first carried out by NIO's *R.V. Gaveshani.* This ship has limited capabilities and endurance. Moreover, it has a heavy work load to fulfil its other oceanographic cruises. Therefore, it was considered necessary to charter more ships and hence *M.V. Skandi* Surveyor was chartered from P/R Oekland & Co., Torangsvaag, Norway.

(3) **M.V. Farnella :** After the recognition of India as "Pioneer Investor" the programme on exploration of polymetallic nodules became time-bound as the coordinate of the mine site is to be registered with the Preparatory Commission in March, 1983. Therefore, to complete the job, one more ship was necessary and hence *M.S. Farnella* was chartered from M/s J. Marr & Sons Ltd, Hull, England.

(4) **M.V. Polar Circle :** The success achieved during the first expedition on board Polar Circle to Antarctica and the lack of availability of other suitable ice-breakers last year, it pormpted the Deptt. to charter *Polar Circle* again for the second expedition to Antarctica. However, for this charter, the accommodation in the ship has been increased from 21 to 28 members.

(5) **Procurement of an ice-breaker :** A Task Force has been constituted under the Chairmanship of Additional Secretary DOD for working out specification, user requirements, operating conditions, time schedule of construction, etc. in respect for an ice breaker. This ice breaker will be used for the Antarctic programme. The Task Force will shortly be submitting its report.

(6) **Procurement of an aircraft :** In due course, as India plans to have a manned station at Antarctica, an aircraft, which could land on ice, would be necessary and plans are underway towards acquiring a suitable aircraft.

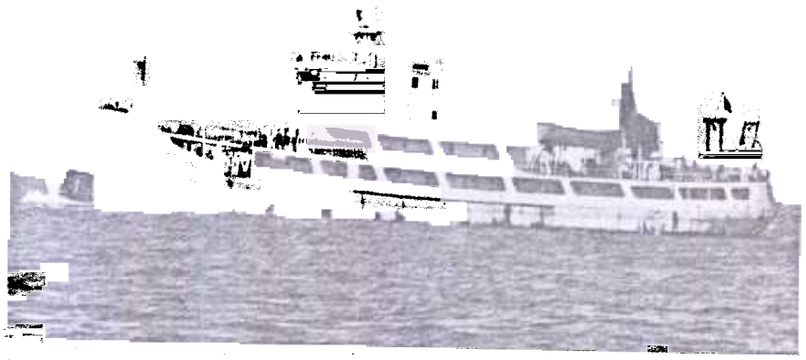


Fig. 13 Research Vessel "Gaveshani" which has carried out pioneering exploration for polymetallic nodules.

SPECIFICATIONS

Length	68. 33m	Tonnage	1900
Breadth	12.19 m	Endurance	25 days
Draught	3.00 m	Speed	10 knots

Accommodation :
Scientists
Officers and Crew

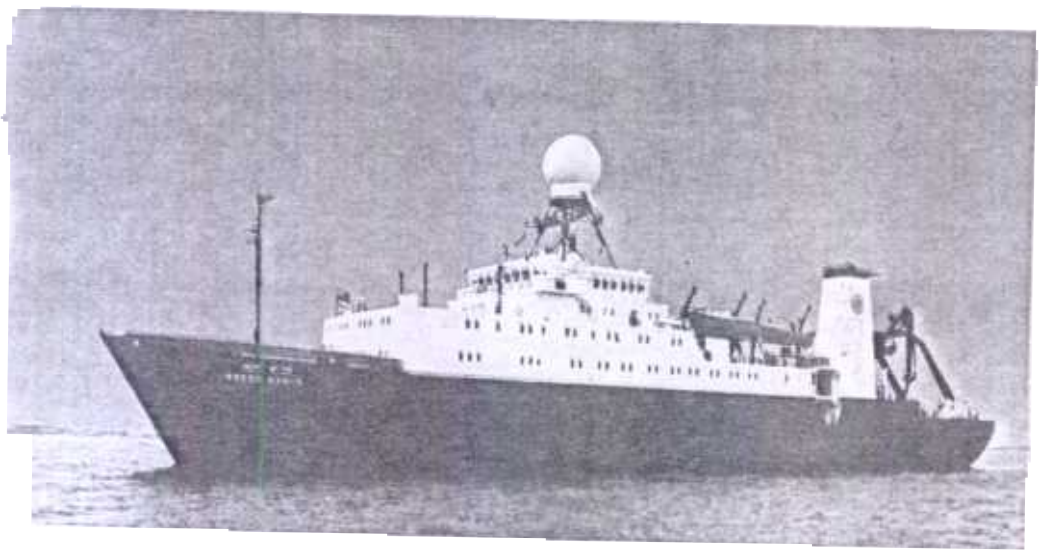


Fig. 14 Research Vessel "Sagar Kanya" built for India at a West German Shipyard.

SPECIFICATIONS

Length	100 m	Accomodation :	
Breadth	16.3 m	Scientists	35
Gross Tonnage	4500	Officers and Crew	56
Endurance	45 days	Speed	14.25 knots

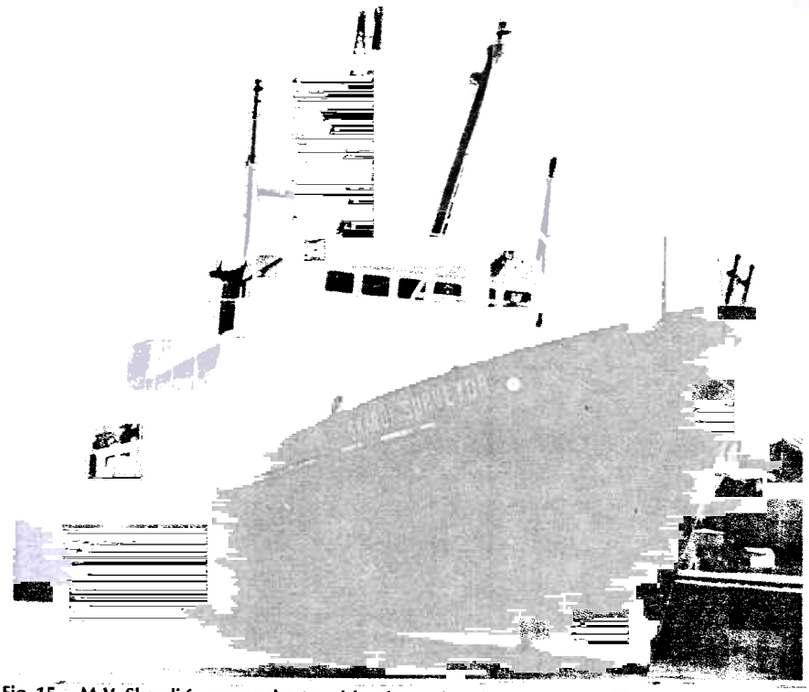


Fig. 15 M.V. Skandi Surveyor chartered for the exploration of polymetallic nodules in the Indian Ocean.

SPECIFICATIONS :

Length	73.26 m	Breadth	11.58 m
Draught	4 m	Tonnage	1200
Endurance	40 days	Accommodations :	
		Scientists	30
		Officers and Crew	44
		Speed	14 knots

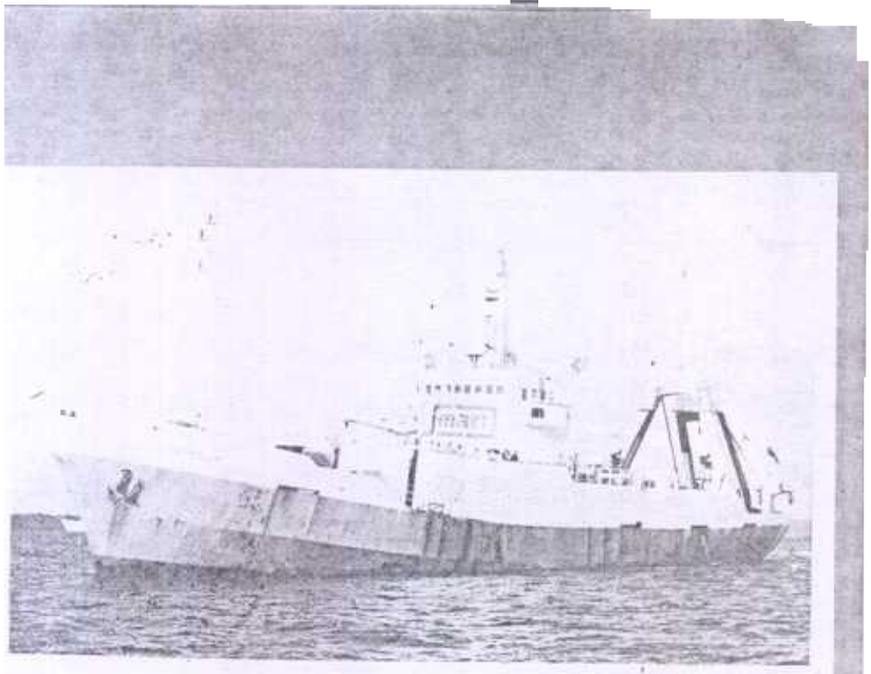


Fig. 16 MV Farnella chartered for the exploration of polymetallic nodules in the Indian Ocean.

SPECIFICATIONS

Length	76.60 m
Breadth	12.65 m
Draught	4.00 m
Tonnage	1238
Endurance	50 days

Accommodation

Scientists	20
Officers and Crew	16
Speed	15 knots

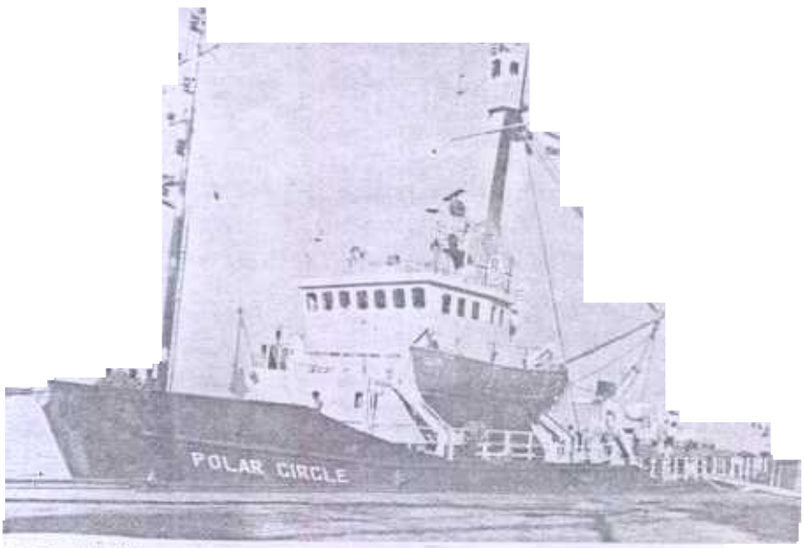
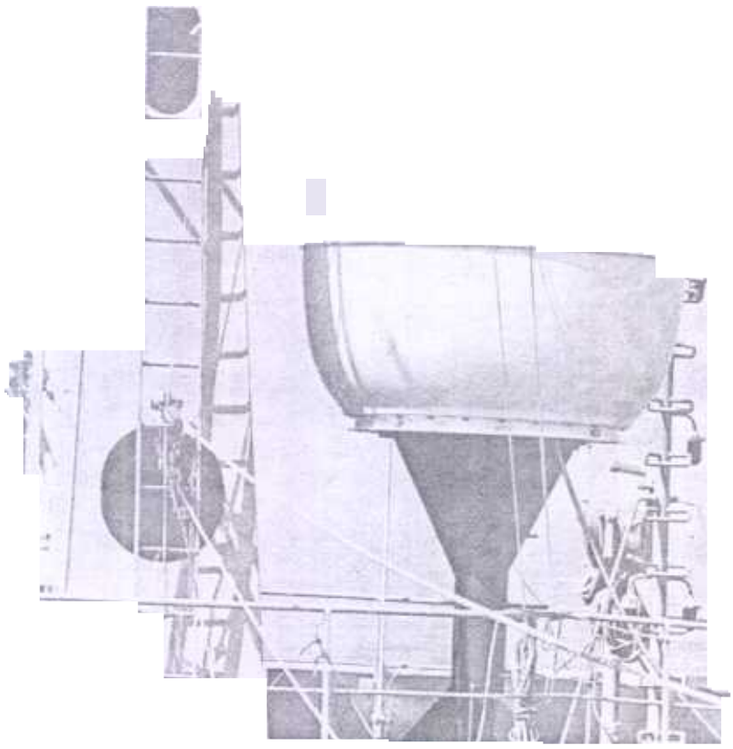


Fig. 17 MV Polar circle chartered for the first and second expeditions to Antarctica

SPECIFICATIONS

Length	49.615 m	Breadth	11.500 m
Draught	4.793 m	Tonnage	974.85
Endurance	45–50 days	Accommodation	
		Scientists	
		Officers and Crew	



7. TRAINING OF MANPOWER AND EXTRA POSITIONS

The proposed developmental programmes in the marine sector call for manpower planning and the availability of trained personnel in the country for the inshore, offshore and deep sea management. Ocean development would demand activities related to scientific, engineering and technical manpower in the light of the new research vessels which will be available in India. These will not only require scientists and technicians, but also supporting staff in the from of base facilities, workshops and laboratories and adequate institutional base.

Since the new research vessel is being temporarily entrusted for operational purposes to CSIR/NIO, the Department has provided extra positions of scientists, technicians and other supporting staff to several institutions. The new staff will be first trained in general oceanography and later on in their special disciplines, including shipboard work. The first batch of scientists have been recruited in August, 1982 and the training of this batch finished in February, 1983.

The trainees have been exposed to oceanographic work in which lectures were arranged by experts in different disciplines. They were also taken on cruises of *R.V. Gaveshani.* The Department has earmarked additional funds for training programmes. The extra positions have been created largely in marine geology, marine instrumentation and ocean engineering.

8. SUPPORT AND ASSISTANCE PROVIDED BY THE DEPARTMENT

There are several agencies and institutions in the country working in the Ocean Sector. A list of research and academic institutes connected with Ocean Science, Ocean Engineering and Ocean Technology is given in Annexure 2.

The Department has supported either fully or partially many research programmes. The two major programmes supported in full are the Antarctic Research and the Exploration of Polymetallic Nodules in the Indian Ocean. The details of these have already been given earlier. So far, a sum of Rs. 3.70 crores has been provided to NIO/CSIR for the polymetallic nodules project alone.

International Training Programme on Marine Resources Management and Conservation in the Indian Ocean Basin and Adjacent Seas : The Department organised an International Training Programme on the above subject in collaboration with the International Ocean Institute, Malta and the National Institute of Oceanography from 4 Oct. to 10 Dec. 1982 at Goa. The other co-sponsors of this programme were CIDA, FAO, UNEP, IOC and Commonwealth Secretariat. The objective of this programme was to assist other developing countries of the region in training of mid-level manpower and also to evolve a mechanism for integrated approach towards the utilization of marine resources as part of a strategy for ocean management.

The participants were selected from countries bordering the Indian Ocean including India. In all, there were 23 participants : 10 from India—representing Geological Survery of India, Oil & Natural Gas Commission, Coast Guard, Indian Navy, central Marine Fisheries Research Institute (ICAR) and Indian institute of Technology and 13 from neighbouring countries namely Iran, Iraq, Phillipines. Sri Lanka, Thailand, Vietnam and Sudan.

About 40 Indian and 30 foreign experts were invited to deliver leactures on various themes which covered general introduction to Indian Ocean research; management of living and non-living resources; environment and development : navigation and shipping in the Indian Ocean and adjacent seas and marine scientific research, planning and policy. In addition, it also included visits to important organisations in India, Maldives and Sri Lanka. At the end of this course, a panel discussion was held at Bombay to evaluate the project reports prepared by the participants. The panel consisted of Indian as well as foreign experts. The following points emerged in the concluding session :

1. There was a general consensus that the new regime of the oceans following the signing of the UNCLOS convention by majority of the countries imposes great responsibility for proper utilisation of ocean resources both in EEZ as well as in the international seabed regime on all the members.

2. It was felt that regional as well as international cooperation are essential for the proper management of the marine resources.
3. It was felt that a regional centre should be established in the Indian Ocean Region for transfer of technology among the developing countries.
4. A model structure for administering and planning of ocean development should be established in each of the participating countries.
5. There is need for proper organisation with reference to monitoring, surveillance and enforcement both at the national and international level.

addition, assistance was provided to other Institutions as follows

	Project	Name of the Organization	Amount
	Politico-geographic/Social Dimensions of Antarctica-Indian Ocean Development	Department of Political Science Punjab University, Chandigarh	Rs. 13,250
2.	Wave energy programme	Indian Institute of Technology Madras	Rs. 10,00,000
	Visual presentation of Ocean Development Activities	Indian Science Congress Association, Calcutta	Rs. 25,000
	Symposium on Fluid Mechanics and Fluid Power	Bharat Heavy Electricals Ltd, Hyderabad	Rs. 2,500
5	Seminar on Indian Ocean	Department of Defence Studies, University of Allahabad, Allahabad	Rs. 2,500

BUDGET

The total budget estimates (BE) of the Department for the year 1982-83 was Rs. 1710 lakhs while revised estimates (RE) for the same year was Rs. 4534 lakhs. A budget estimate of Rs. 3200 Lakhs has been proposed for the year 1983-84.

A Summary of the financial requirement is given below :

PLAN (Rs. in lakhs)

Sl. No.	Item	BE 1982-83	RE	BE 1983-84
	Antatctic Research Program	1.00	275	700
2	Acquisition of research vessel			
	(i) ORV	1310.00	2010	1100
	(ii) FORV	100.00	1700	50
	(iii) Other vessels	15.00	5	300
3.	Polymetallic nodule programme	220.00	520	960
4	Studies on prevention of coastal erosion (wave studies)	25.00	10	25
5	Marine research development fund	30.00	8	30
6.	Other schemes	2.00	2	23
	Other expenditure (Secretariat)	7.00	4	12

NON-PLAN

The non-plan component is required only for the Secretariat to the tune of Rs. 17.80 lakhs under revised estimate during 1982-83 as against a budget estimate of Rs. 9.30 lakhs. During the year 1983-84 an amount of Rs. 26.75 lakhs has been proposed under the 'Secretariat'.

Annexure 1 A

RASHTRAPATI BHAVAN
NEW DELHI

24th July, 1981
2nd Sravana, 1903 (S)

NOTIFICATION

In exercise of the powers conferred by clause (3) of articles 77 of the Constitution, the President hereby makes following rules further to amend the Government of India (Allocation of Business) Rules, 1961, namely :—

1. These rules may be called the Government of India (Allocation of Business) (One Hundred and fortyeight Amendment) Rules, 1981.

2. In the Government of India (Allocation of Business) Rules, 1961:—

(a) In the First Schedule, for entry "30 Cabinet Secretariat (Mantrimandal Sachivalaya)", the following entry shall be substituted, namely :—
"30. Cabinet Secretariate (Mantrimandal Sachivalaya) (With a Department of Ocean Development (Mahasagar Vikas Vibhag) with in the Secretariat (Sachivalaya)".

(b) in the Second Schedule:—

(i) under the heading "DEPARTMENT OF SCIENCE AND TECHNOLOGY (VIGYAN AUR PRODYOGIKI VIBHAG)", entries 4 and 14 shall be omitted;

(ii) under the heading "CABINET SECRETARIAT (MANTRIMANDAL SACHIVALAYA)" and the entries thereunder, the following sub-heading and entries shall be inserted, namely :—

'DEPARTMENT OF OCEAN DEVELOPMENT (MAHASAGAR VIKAS VIBHAG)

1. Matters relating to the Ocean and not specifically allocated to any other Department/ Ministry

2. Policies including coordination, security, regulatory measures and development relating to the Ocean and covering, inter-alia :—

   (i) research (including fundamental research) and the development of uses relatable thereto;

   (ii) technological development;

   (iii) surveys to map and locate the availability of non-living and living marine resources;

   (iv) preservation, conservation and protection;

   (v) development of appropriate skills and manpower;

   (vi) collaboration, including technical collaboration; and

   (vii) laws relatable to the above.

3. Ocean Commision.

4. The Pan-Indian Ocean Science Association

5. Ocean Science and Technology Agency or Board.

Sd/-
N. SANJIVA REDDY
PRESIDENT

Doc. No. CD-161/82

Annexure 1 B

RASHTRAPATI BHAVAN
NEW DELHI

12th February, 1982
23 Magh, 1903 (S)

NOTIFICATION

In exercise of the powers conferred by clause (3) of article 77 of the Constitution; the President hereby makes the following rules further to amend the Government of India (Allocation of Business) Rules, 1961, namely:—

1. (i) These rules may be called the Government of India (Allocation of Business) (One Hundred and fifty-fourth Amendment) Rules, 1982.
(ii) They shall come into force at once.

2. In the Government of India (Allocation of Business) Rules, 1961:—

(a) In the First Schedule:—

(i) after entry "26A. Department of Environment (Paryavaran Vibhag)", the following entry shall be inserted, namely:—
"26B. Department of Ocean Development (Mahasagar Vikas Vibhag)" and

(ii) in entry 30, the brackets and words "with a Department of Ocean Development (Mahasagar Vikas Vibhag)" within the secretariat (Sachivalaya) shall be omitted.

(b) in the second Schedule:—
(i) after the heading "DEPARTMENT OF ENVIRONMENT (PARYAVARAN VIBHAG)" and the entries thereunder, the following heading and entries shall be inserted, namely:—
"DEPARTMENT OF OCEAN DEVELOPMENT (MAHASAGAR VIKAS VIBHAG)"

1. Matters relating to the Ocean and not specifically allocated to any other Department/ Ministry

2. Policies including coordination, security, regulatory measures and development relating to the Ocean and covering, inter-alia:—
(i) research (including fundamental research) and the development of uses relatable thereto;
(ii) technological development;
(iii) surveys to map and locate the availability of non-living and living marine resources;

(iv) preservation, conservation and protection;
(v) development of appropriate skills and manpower;
(vi) collaboration, including technical collaboration; and
(vii) laws relatable to the above.

3. Ocean Commission

4. The Pan-Indian Ocean Science Association

5. Ocean Science and Technology Agency or Board" and

(ii) under the heading "CABINET SECRETARIAT (MANTRIMANDAL SACHIVALAYA)" the sub-heading "DEPARTMENT OF OCEAN DEVELOPMENT (MAHASAGAR VIKAS VIBHAG)" and entries thereunder shall be omitted.

Sd/-
N. SANJIVA REDDY
PRESIDENT

Annexure 2

LIST OF INSTITUTIONS CONNECTED WITH OCEAN SCIENCE ENGINEERING IN INDIA

1. Department of Ocean Development, New Delhi.

Council of Scientific & Industrial Research

2. National Institute of Oceanography, Goa and other Regional Centres.
3. National Geophysical Research Institute, Hyderabad
4. Central Salt and Marine Chemicals Research Institute, Bhavnagar

Defence Research & Development Organisation

5. Naval Physical & Oceanographic Laboratory, Cochin
6. Naval Chemical & Metallurgical Laboratory, Bombay
7. Naval Science & Technological Laboratory, Visakhapatnam
8. Naval Hydrographic Office, Goa

Other Institutions

9. India Meteorological Department
10. Indain Institute of Tropical Meteorology, Pune
11. Indian Institute of Geomagnetism, Bombay
12. Physical Research Laboratory, Ahmedabad
13. Indain Space Research Organisation (Space Applications Centre, Ahmedabad)
14. National Remote Sensing Agency, Hyderabad
15. Institute of Petroleum Exploration (ONGC)
16. Indian Institute of Petroleum (Min. of Petroleum)
17. Central Water & Power Research Station, Pune
18. Bhabha Atomic Research Centre, Bombay
19. Geological Survey of India
20. Zoological Survey of India
21. Central Marine Fisheries Research Institute, Cochin and a number of Regional Centres
22. Central Institute of Fisheries Technology and Regional Centres
23. Exploratory Fisheries Project, Bombay

24. Integrated Fisheries Project, Cochin
25. Centre for Earth Science Studies, Trivandrum
26. Kerala Engineering Research Institute, Trichur

List of Academic and Training Institutions

1. Andhra University
2. Annamalai University
3. Berhampur University
4. Calicut University
5. Cochin University
6. Delhi University
7. Jawaharlal Nehru University
8. Karnatak University
9. Kerala University
10. Konkan Agricultural University
11. Madras University
12. Marathwada University
13. Madurai University
14. Karnatak Regional Engineering College, Surathakal
15. Indian Institute of Science, Bangalore

Organisational Chart of the Department of Ocean Development